Distributed Generation Improvements in Industrial Applications

CHP Integration with Fluid Heating Processes in the Chemical and Refining Sectors

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CHP Integration with Fluid Heating in Chemical and Refining Sectors

- Links to DER Strategy
  - Encourage CHP in Industry (Chemical and Refining)
  - Incremental Fluid Heating CHP Applications Could Double the CHP Potential from Traditional Steam Systems
  - Environmental and Efficiency Benefits

Impact to CHP Opportunity in Chemical and Refining Sectors

- Based on Selected Chemicals and Refining Processes
- 22 GW of Remaining New Steam CHP Potential
- 44 GW of New Fluid Heating CHP Potential

- 66 GW of Total New CHP Potential

- (7 GW of Existing CHP Capacity in Selected SICs)

CHP Integration with Fluid Heating in Chemical and Refining Sectors

- Objectives
  - Estimate the MW Potential of a Larger CHP Market as Compared to Traditional Steam CHP
  - Evaluate Technical Issues Including Temperature Requirements and Process Integration
  - Industrial Survey to Augment Field Findings
  - Recommendations to Overcome Economic and Technical Hurdles

Scope of Work

PROGRESS	• **Task 1: Market Assessment**
Completed	• Identify SICs with fluid heating processes, equipment types, temperatures • Estimate MW potential, develop economic criteria for U.S. • **Task 2: Technical Feasibility** • Detailed evaluation of two fluid heating applications (ethylene plant and refinery)
In progress	• Investigate issues affecting feasibility of CHP integration (economic & environmental) • **Task 3: Industrial Survey** • Discussion Paper • Perform Industrial Survey
TBD	• Recommendations • **Task 4: Final Report**

Task 1.1 - Fluid Heating Processes

Refining Processes	Fluid Heating CHP (GW)
Distillation	
Atmospheric	10
Vacuum	3
Coking	4
Catalytic Processes	
Fluid Cracking	3
Reforming	8
Hydrocracking	2
Hydrotreating	5
Total	**34**

Chemical Processes	Fluid Heating CHP (GW)
Ethylene	5.50
Ammonia	1.9
Carbon Black	0.57
Methanol	0.48
Urea	0.27
Styrene	0.24
Vinyl Chloride	0.22
Benzene, Toulene, Xylenes	0.18
Soda Ash	0.08
Propylene Oxide	0.08
Propylene Oxide	0.08
Caprolactam	0.05
Acrylonitrile	0.01
Total	**9.66**

Task 1.2 & 1.3 - Target Markets

- **Regions with Positive "CHP Spark Spread"**
  - Texas (14 GW)
  - Louisiana (7.8 GW)
  - California (4.8 GW)
  - Pennsylvania (1.3 GW)
  - New Jersey (1.2 GW)
  - Washington (1.2 GW)
  - Minnesota (0.7 GW)

  - Note: "CHP spark spread" is defined as average industrial electric price compared to cost of power from a 5MW CHP system including fuel, capital and O&M

Task 2.1 - Technical Assessment

- **Direct-Coupled CHP** (e.g. ethylene plant example)
  - Gas Turbine Exhaust Used as Combustion Air to Furnace
  - Can be integrated with all process temperature requirements
  - Gas turbine selection based on mass flow through furnace
  - Design sensitive to exhaust O_2 content and temperature
  - Gas turbines with lower inlet temperatures with higher O_2 preferred
  - Single shaft turbines exhibit favorable thermal inertia characteristics in the case of an emergency shut-down

Task 2.1 - Technical Assessment

- **Indirect-Coupled CHP** (e.g. Paramount Refinery)
  - Gas turbine exhaust is directed to a waste heat exchanger (no fluid mixing)
  - Well suited to convection heat transfer applications (no-high temperature radiant duty)
  - Not suitable for processes with high-temp endothermic “cracking” chemical reactions
  - Fluid heating and steam generation can be accomplished in a single waste heat exchanger

Progress to Date

	Progress Report Submitted
Task 1: Fluid Heating Market	
Identify SICs with Fluid Heating (Task 1.1)	✓
Database Screening (Task 1.1)	✓
Economic Criteria (Task 1.2)	✓
Target Markets (Task 1.3)	✓
Task 2: Site Evaluation	
Performed Refinery Site Visit (Task 2.1)	✓
Performed Technical Assessment (Task 2.1)	✓
Economic and Environmental Assessment (Task 2.2)	
Recommendations (Task 2.3)	
Task 3: Industrial Survey	
Discussion Paper (Task 3.1)	
Perform Industrial Survey (Task 3.2)	
Recommendations (Task 3.3)	
Task 4: Final Report	

Schedule

	Description	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02	May-02
TASK 1	FLUID HEATING CHP MARKET											
TASK 2	SITE EVALUATION OF FLUID HEATING CHP											
TASK 3	INDUSTRIAL SURVEY											
TASK 4	FINAL REPORT